

Application Ser. No.: 10/018,219
Attorney Docket No.: CNF-002

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1-77 (canceled)

Claim 78 (new): A downhole pump comprising: a first body comprising a stator, a second body comprising a rotor, the rotor being provided within the stator and carrying at least one piston, a chamber within the rotor, an inlet to the chamber provided at an upstream end of the chamber, and an outlet from the chamber provided at a downstream end of the chamber, the at least one piston being provided longitudinally between the inlet and the outlet, the at least one piston comprising a means for varying a volume of the chamber, and the at least one piston being mounted in a respective aperture passing through a side wall of the rotor, the respective aperture being substantially transverse to a longitudinal axis of the pump, wherein, in use, relative rotation of the rotor and the stator causes reciprocal movement of the at least one piston within the respective aperture thereby varying the volume of the chamber, whereby well production fluid is caused to be pumped downstream through the chamber.

Claim 79 (new): A downhole pump as claimed in claim 78, wherein relative rotation of the rotor and stator occurs, in use, along a longitudinal axis of the rotor or the stator.

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Claim 80 (new): A downhole pump as claimed in claim 78, wherein the first and second bodies are substantially concentric one with the other.

Claim 81 (new): A downhole pump as claimed in claim 78, wherein the first and second bodies are substantially eccentric relative to one another.

Claim 82 (new): A downhole pump as claimed in claim 78, wherein the chamber is provided substantially longitudinally within the second body.

Claim 83 (new): A downhole pump as claimed in claim 78, wherein the at least one piston is supported by the second body and biased by means towards the first body.

Claim 84 (new): A downhole pump as claimed in claim 83, wherein the first end of the at least one piston communicates with the chamber and a second end of the at least one piston is urged by the respective biasing means into contact with an inner surface of the first body.

Claim 85 (new): A downhole pump as claimed in claim 78, wherein the first body has a substantially elliptical, oval or cylindrical inner surface.

Claim 86 (new): A pump as claimed in claim 85, wherein the second body has a substantially cylindrical or elliptical outer surface.

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Claim 87 (new): A downhole pump as claimed in claim 78, wherein the bore comprises a substantially cylindrical internal bore.

Claim 88 (new): A downhole pump as claimed in claim 78, wherein the means for varying the volume of the chamber comprises the at least one piston which is supported by the second body and biased by means towards the first body.

Claim 89 (new): A downhole pump as claimed in claim 78, wherein the inlet includes a first valve means.

Claim 90 (new): A downhole pump as claimed in claims 89, wherein the inlet also includes one or more back-up valves.

Claim 91 (new): A downhole pump as claimed in claim 78, wherein the outlet includes a second valve means.

Claim 92 (new): A downhole pump as claimed in claim 91, wherein the outlet also includes one or more back-up valves.

Claim 93 (new): A downhole pump as claimed in claim 78, wherein there is provided at least one pair of pistons supported by the second body and radially opposing one another relative thereto.

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Claim 94 (new): A downhole pump as claimed in claim 93, wherein there are provided a plurality of pairs of pistons, each pair being longitudinally spaced from an adjacent pair along the second body.

Claim 95 (new): A downhole pump as claimed in claim 78, wherein the at least one piston includes a rotatable member free to rotate at least along a longitudinal axis with respect to the rotor.

Claim 96 (new): A downhole pump as claimed in claim 95, wherein the at least one piston includes a piston member, the piston member including a concave portion capable of receiving at least a portion of the rotatable member.

Claim 97 (new): A downhole pump as claimed in claim 95, wherein each rotatable member is in the form of a sphere.

Claim 98 (new): A downhole pump as claimed in claim 96, wherein each rotatable member is in the form of a cylinder.

Claim 99 (new): A downhole pump as claimed in claim 78, wherein the means for varying the volume of the chamber is driven by drive means.

Claim 100 (new): A downhole pump as claimed in claim 99, wherein the drive means includes a drive shaft for rotating the rotor, in use.

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Claim 101 (new): A downhole pump as claimed in claim 78, wherein the rotor is provided with at least one seal or bushing for sealing engagement with the stator.

Claim 102 (new): A downhole pump as claimed in claim 101, wherein the at least one seal is made from a material selected from the group consisting of: plastics materials, polyethylethylketone, metal, copper alloys and stainless steel.

Claim 103 (new): A downhole pump as claimed in claim 96, wherein the piston member is made from a material selected from the group consisting of: plastics materials, polyethylethylketone, metal, copper alloys and stainless steel.

Claim 104 (new): A downhole pump as claimed in claim 78, wherein the at least one piston is hollow, spherical, cylindrical, cuboid or polygonal.

Claim 105 (new): A downhole pump as claimed in claim 95, wherein the rotatable member is made from material selected from the group consisting of: plastics materials, polyethylethylketone, metal, copper alloys and stainless steel.

Claim 106 (new): A downhole pump as claimed in claim 95, wherein the rotatable member is hollow, spherical or cylindrical.

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Claim 107 (new): A downhole pump as claimed in claim 84, wherein the biasing means are made from a material selected from the group consisting of: plastics materials, polyethylethylketone, metal, copper alloys and stainless steel.

Claim 108 (new): A downhole pump as claimed in claim 78, wherein the rotor is provided with at least two piston apertures which are disposed substantially opposite one another, each of the piston apertures being provided with a respective piston.

Claim 109 (new): A downhole pump as claimed in claim 108, wherein each piston has a slot, hole or gap to allow fluid to flow through the piston from the chamber, which fluid flow assists in lubricating contacting surfaces of the at least one piston and the stator and the at least one piston and the rotor.

Claim 110 (new): A downhole pump as claimed in claim 78, wherein the pump comprises or includes a plurality pistons and respective biasing means, wherein each piston biasing means works individually in series or in parallel with one another.

Claim 111 (new): A downhole pump as claimed in claim 110, wherein the second body is provided with a plurality of pistons arranged in pairs, each aperture of each pair being substantially opposite to the other.

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Claim 112 (new): A downhole pump as claimed in claim 111, wherein one biasing means is used for each piston of a pair by traversing the chamber but not cutting off fluid flow through the chamber.

Claim 113 (new): A downhole pump as claimed in claim 78, wherein one or more one way valves are provided at the inlet and one or more further one way valves are provided at the outlet of the pump allowing fluid flow to travel through the chamber.

Claim 114 (new): A downhole pump as claimed in claim 78, wherein at least one first vent hole is provided at a predetermined position through the first body, allowing any pressure differential across the first body to be equalised and held to the pressure external to the pump in use.

Claim 115 (new): A downhole pump as claimed in claim 114, wherein the second body is provided within at least one bearing pack which includes at least one radial bearing and at least one thrust bearing.

Claim 116 (new): A downhole pump as claimed in claim 115, wherein the bearing pack includes at least one seal at a fluid upstream end and at least one seal at a fluid downstream section end of the least one bearing pack.

Claim 117 (new): A downhole pump as claimed in claim 115, wherein at least one second vent hole is provided at a predetermined position through a bearing housing, allowing any

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pressure differential across the bearing pack(s) to be equalised and held to the pressure external to the pump in use.

Claim 118 (new): A downhole pump as claimed in claim 78, wherein the rotor is connected to a drive means by a spline, hex or polygon coupling.

Claim 119 (new): A downhole pump as claimed in claim 99, wherein the drive means is selected from a hydraulic, pneumatic or electric drive means.

Claim 120 (new): A downhole pump as claimed in claim 78, wherein there is provided a filter means associated with the inlet and means for cleaning the filter means.

Claim 121 (new): A downhole pump as claimed in claim 120, wherein the filter means comprises a substantially cylindrical body.

Claim 122 (new): A downhole pump as claimed in claim 120, wherein the filter means carries an end plate.

Claim 123 (new): A downhole pump as claimed in claim 120, wherein the filter means is formed from a sheet form mesh material.

Claim 124 (new): A downhole pump as claimed in claim 120, wherein the means for cleaning the filter means is driven by a drive means.

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Claim 125 (new): A downhole pump as claimed in claim 120, wherein the filter means is rigidly attached to the second body so as to rotate therewith, in use.

Claim 126 (new): A downhole pump as claimed in claim 119, wherein the means for cleaning comprise at least one blade, knife or scraper substantially rigidly attached to the stator.

Claim 127 (new): A downhole pump as claimed in claim 126, wherein the least one blade has a serrated edge or surface which, when coming into contact with the filter means, in use, act to allow any debris or contamination build upon the filter means to be removed.

Claim 128 (new): A downhole pump as claimed in claim 120, wherein the filter means is made from a material selected from the group consisting of: plastics materials, polyethylethylketone, metal, copper alloys and stainless steel.

Claim 129 (new): A downhole pump as claimed in claim 126, wherein the at least one blade is made from a material selected from the group consisting of: plastics materials, polyethylethylketone, metal, copper alloys and stainless steel.

Claim 130 (new): A downhole assembly comprising a plurality of downhole pumps, each pump comprising a pump according to claim 78, the plurality of pumps being so arranged as to be operatively connected with one another.

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Claim 131 (new): A downhole assembly as claimed in claim 130, wherein the pumps are arranged so that, in use, the pumps operate substantially in phase with one another and are not separated by a one way valve(s).

Claim 132 (new): A downhole assembly as claimed in claim 130, wherein the pumps are arranged so that, in use, the pumps operate substantially out of phase with one another.

Claim 133 (new): A downhole assembly as claimed in claim 132, wherein two pumps with two chambers are connected 90 degrees out of phase with one another.

Claim 134 (new): A downhole assembly as claimed in claim 132, wherein two pumps each with four chambers are connected 45 degrees out of phase.

Claim 135 (new): A well completion including at least one downhole pump according to claim 78.

Claim 136 (new): A method of artificial lift within an oil/gas well comprising the steps of:
providing at least one downhole pump according to claim 78;
lowering the at least one downhole pump to a desired position within a borehole of a well;
driving the at least one downhole pump so varying the volume of the chamber therein, thereby pumping well fluids downstream through the at least one pump and a tubing of the well.

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Claim 137 (new): A method of artificial lift as claimed in claim 136, wherein the tubing comprises coiled tubing upon which the at least one downhole pump is lowered within the borehole.

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Amendments to the Drawings

The attached sheet of drawings in the Appendix includes changes to Fig 1 and addition of new Fig 6. This sheet, which includes Fig 1-3 and 6, replaces the original sheet that included Fig 1-3.

In Fig 1, the enlarged view of the filter means associated with the inlet of the pump as been removed. This enlarged view of the filter means has now become Fig 6.

Appendix: Replacement Sheet
Annotated Sheet showing changes